INTERNET ARCHIVE
WaybackMachine

Enter Web Address: http:// All Take Me Back Adv. Search

Searched for **http://www.semiconductorfabtech.com/features/lithography/articles/body3.195.php3** **1** Results

* denotes when site was updated.

Search Results for Jan 01, 1996 - Jun 07, 2004

1996	1997	1998	1999	2000	2001	2002	2003	2004
0 pages	0 pages	0 pages	0 pages	1 pages	0 pages	0 pages	0 pages	0 pages
				Dec 10, 2000 *				

Home | Help

Automated Reticle Management Increases Efficiency, Throughput, and Capital Investment Utilization

Denise Dillon Harris, PRI Automation, Billerica, Massachusetts, USA.

Abstract

Automated material handling and management within photolithography are is helping semiconductor manufacturers meet the challenges of higher throughput, improved equipment utilization, increased yield and more. Automation benefits can be evaluated through consideration of cleanliness, space cost savings, efficiencies, and material management.

Fab expansions, high throughput and wide product offerings are only a few of the contemporary issues effecting semiconductor photolithography areas. These concerns, combined with advances in product design, create new and complex manufacturing challenges that must be overcome. Advanced semiconductor facilities want to leverage the best return from their clean room and factory control capital investments by optimizing efficiencies, yield, cost control and material handling methods. These critical success factors, can be better managed and improved upon through the use of automation.

Increasing Reticle Inventories

The number of reticles necessary to complete the imaging of a typical device has increased, as have the variety and number of devices produced. These two factors have had a great impact on the active reticle inventories at many advanced fabs. Faced with these increasing logistical problems, manufacturers need to control the overall management of their reticles in order to maintain or improve their process throughput.

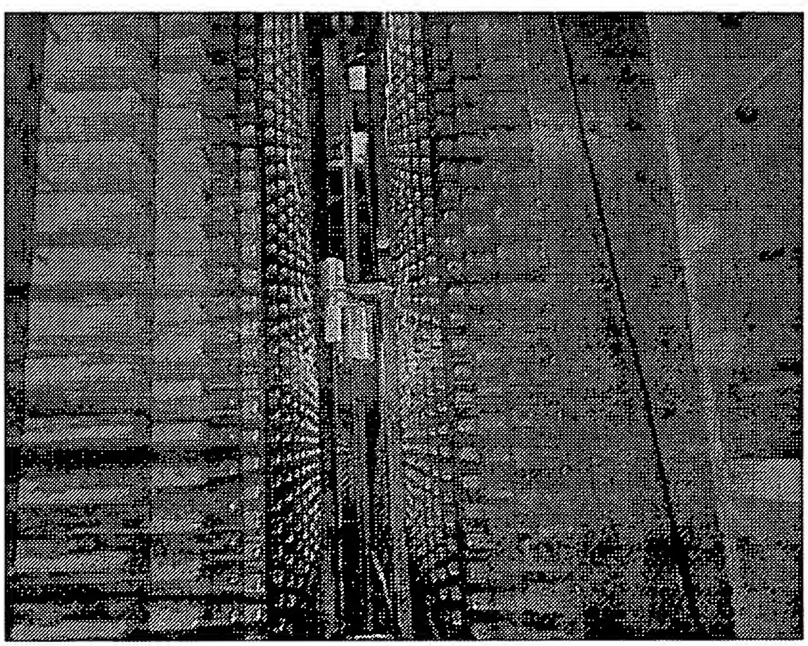

Photo A. High density reticle storage

Informal surveys of manual reticle management practices within photolithography areas have revealed that the time spent to find a specific reticle can average from a few minutes to several hours. Due to human error, reticles can often be left on carts, placed in incorrect storage locations or even be left forgotten at a process station. Operators are found searching stepper work areas and other locations until the reticle is found. This reduces operator productivity and increases equipment downtime.

Automated methods ensure minimal reticle search and retrieval time, as low as 30 seconds, and also provide accurate and consistent store and retrieval intervals. Reliable retrieval times allow lithography technicians to accurately estimate and plan the material flow within their work areas. These benefits minimize equipment downtime and improve equipment utilization.

Cleanroom Space Considerations

Class 1 clean rooms, characteristically having high square foot value, present many cost containment issues associated with storing an increasing inventory of reticles. Most facilities maintain stringent space management practices and a common priority is to minimize inefficient use of clean room space. In order to achieve this, facilities often demand an evaluation and improvement of material storage methods.

Typical manual rack systems for storing an average inventory of reticles require a minimum of 100 square feet of floor space (see photo B). This space estimate includes the unusable aisle space needed for operator access to each reticle. This not only proves to be a spatially inefficient method for storing reticles, but also lacks the management and tracking benefits offered by automation.

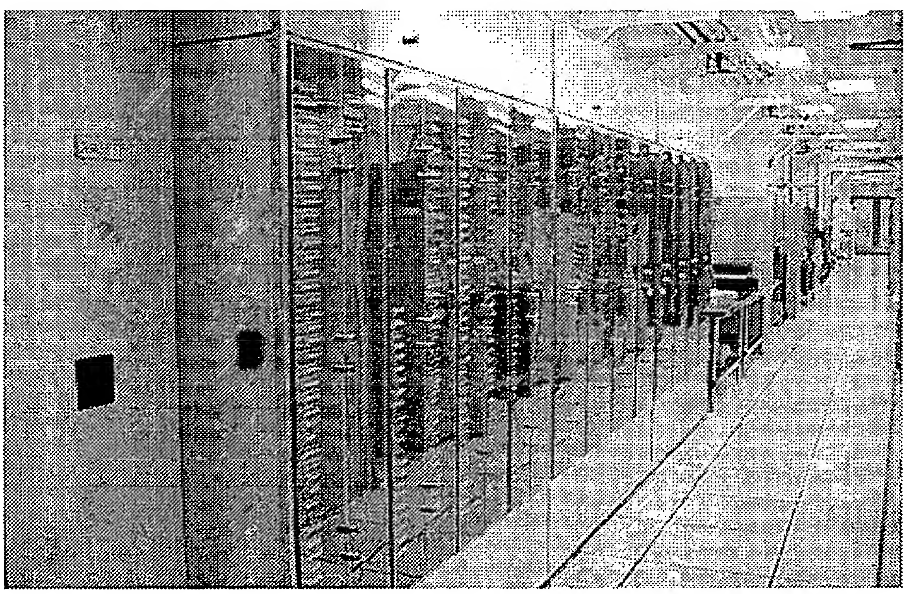

Photo B.Manual rack system.

Automated reticle management systems (ARMS) prove to be a more efficient, compact storage solution than manual rack methods. For comparable reticle inventories (approximately 1000), an ARMS reduces the necessary storage and access space by a total of 64 square feet (see Fig. 1). At a clean room space cost of $3,000 per square foot, the space savings total $192,000. In many cases, this return-on-investment alone can pay for 60-100% of the ARMS acquisition cost.

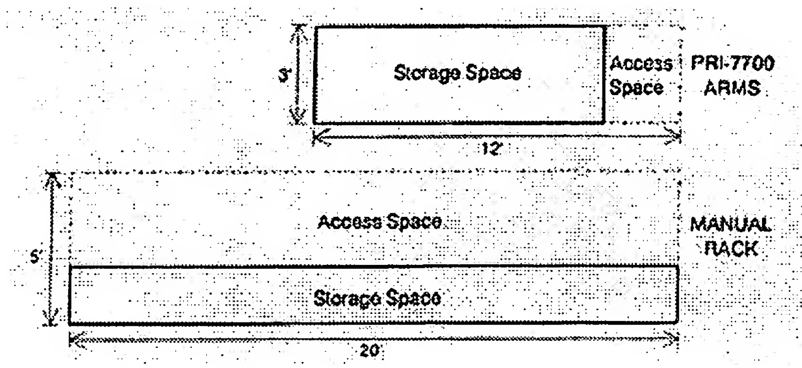

Figure 1.Storage space comparison (approximately 1000 reticle boxes).

Reticle Storage Cleanliness

Maintaining cleanliness within a reticle storage area is a difficult challenge. Many manual rack methods don't account for air flow considerations and require operator handling which contributes to particulate contamination.

Ultra-clean ARMS storage environments use a variety of methods to achieve cleanliness levels that routinely exceed Class 1 at 0.1 micron per Fed-Std-209E. Within Class 1 areas, ARMS storage environments often take advantage of the available ultra clean room air. Vertically directed air is captured from the fab ceiling via an airflow skirt that directs it into an internal air management system which converts it from vertical airflow to horizontal for directed passage over reticle boxes. For applications in non-clean areas, ARMS environments are available with point-of-use ULPA filtration to convert non-clean air supplies into Class 1. An open shelf design, incorporating anti-static shelf materials also contributes to lowering particle counts on box surfaces. In addition to the use of anti-static shelf materials, air ionization systems are available to prevent reticle ESD damage.

Optimizing Factory Control Investments

Factory control technology helps to ensure efficient, defined scheduling of material movement throughout the fab, however within many lithography areas reticle handling still requires human intervention for the act of storing and locating reticles. Some facilities do have limited automation through the use of bar code scanners that log reticle box identification into a host database. This application does automate reticle tracking; however, it still requires an operator to match the box identification with an assigned shelf. If the reticle is placed in the wrong location, retrieval time could be extensive and reticles could even be lost. This manual process proves less efficient than totally automated methods and presents opportunities for material handling errors which are often costly and difficult to recover from despite computer tracking.

Introducing the use of an ARMS (see photo C) and other material transport and loading equipment into a photolithography area totally automates the management and tracking of reticles. An ARMS' database will maintain all necessary information for tracking purposes within the storage environment. When retrieving a reticle, an operator selects the desired reticle ID at any convenient host terminal or ARMS interface, and upon the operator's arrival at the storage system, the box is queued in the output port: no searching or verifying is necessary. This greatly minimizes inefficient operator searches. In addition, without automated management there is often times no reliable method to monitor the number of times a reticle is used and cleaned. In order to ensure clean reticles, many process procedures require inspection and cleaning before each stepper use; thus adding 12 to 20 minutes to

each layer's cycle time. Automated management and tracking provides accurate usage data which process technicians can use to improve cleaning procedures and minimize cleaning frequency. This saves unnecessary cleaning steps, reduces reticle wear, and improves process throughput.

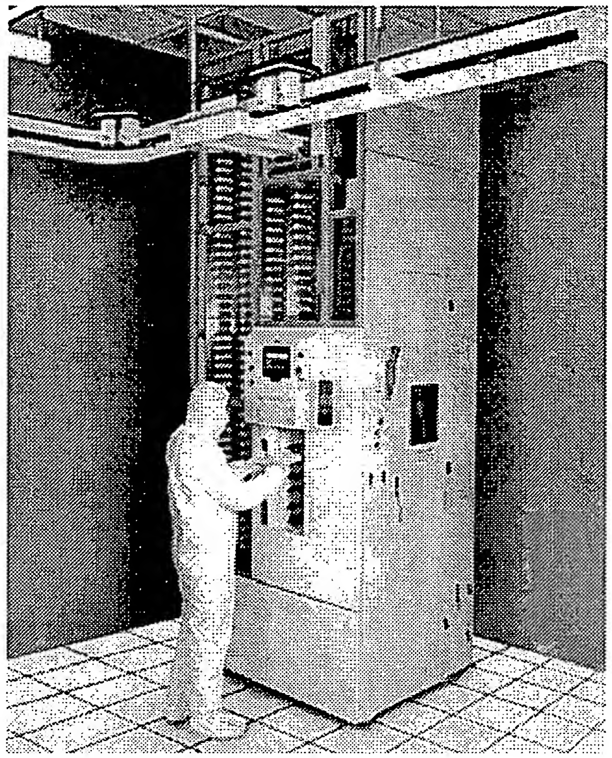

Photo C. Automated reticle management system integrated with a monorail system (for clarity, shown with panels removed).

Automated Reticle Management Systems (ARMS)

Automated reticle management systems provide necessary storage capacities within a compact, Class 1 - or better - footprint. Systems can be configured to store any type of reticle box including Canon, GCA, Nikon and others. They can also accommodate bare reticles. Storage capacity requirements are met through modular system configurations, including height and length combinations.

To store a reticle, a process technician places a reticle box in the input/output port. The internal robot arm will retrieve the reticle box - or reticle - and transport it to an internal bar code reader. The reticle box is scanned, an available box location is identified and logged into the ARMS supervisory database (see photo D).

Photo D. Reticle box is scanned and logged into supervisory computer.

The box is then transported to the available location and stored (see photo E). The system manages reticle location, usage, cleaning and operator ID. If linked to a host, reticle activity can be managed throughout the entire photolithography process.

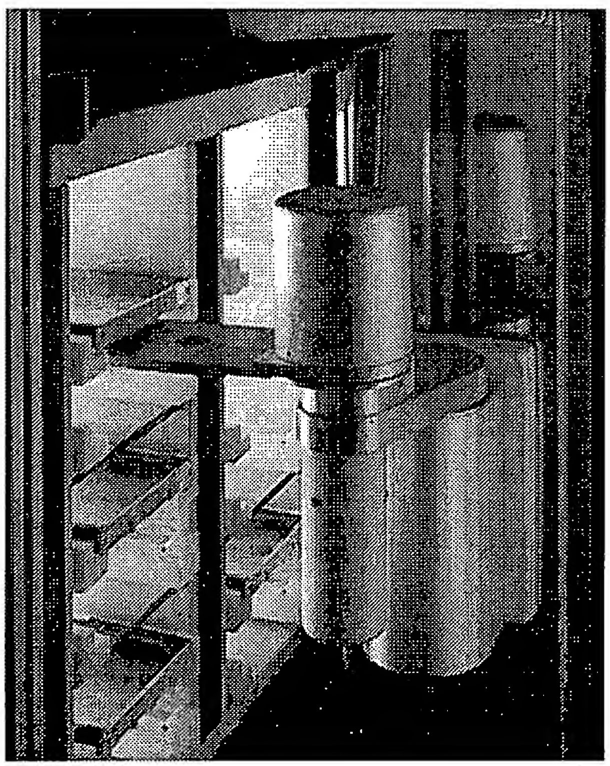

Photo D. Reticle is stored.

Automated Transport, Delivery and Stepper Loading

In order to achieve a more complete level of automation and distributed reticle management, ARMS can be integrated with an overhead monorail system and stepper loading systems.

Implementing distributed reticle management allows "inactive" reticles to be stored in a large ARMS off site or in a less costly space. "Active" reticles can be stored in an ARMS system in or near a

photolithography bay. If an "inactive" reticle is needed, it can be located using the database and then automatically transferred into an active reticle stocker. This minimizes the use of valuable cleanroom space while maintaining easy access to all reticles. Reticle distribution can be further localized by automatically routing reticles to stepper loading systems which include storage buffers right at the process station (see Fig. 2).

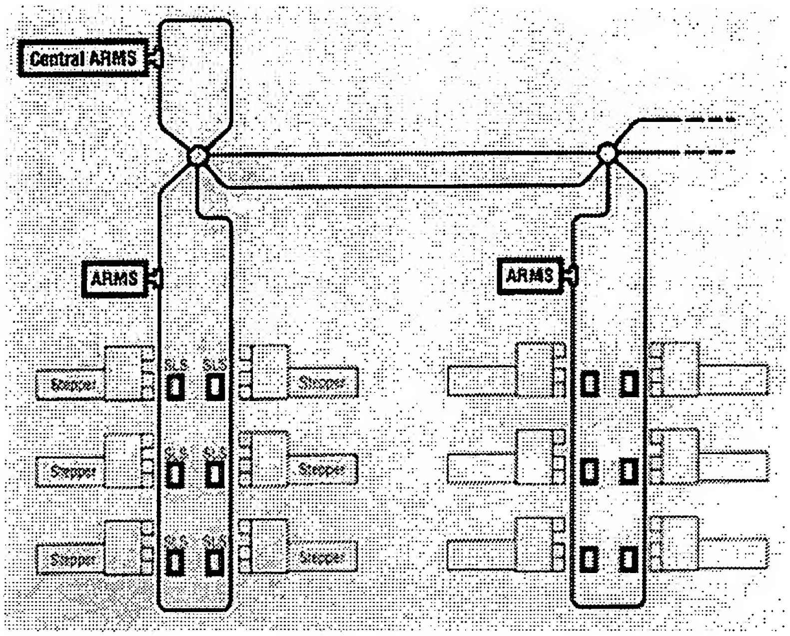

Figure 2.Distributed automated reticle management.

A closed loop, distributed storage and delivery system ensures that the correct reticle is always delivered just-in-time to the correct stepper, thus increasing tool utilization and eliminating lot miss-processing. Upon stepper request that a reticle is needed, the supervisory system locates the necessary reticle within an ARMS. The reticle is then directed to an overhead monorail where it is transported to a stepper loading system. The stepper loading system picks the reticle box from the monorail car and loads it directly to the reticle magazine inside the wafer stepper mini-environment. If the stepper is not ready to receive the reticle, it is held temporarily in buffer storage within the stepper loading robot until the stepper is available. This process is reversed for stepper unloading, thus providing immediate availability for the next process cycle (see Fig. 3). Other transport technologies available include inter-floor transfer modules for transporting reticles to other floors.

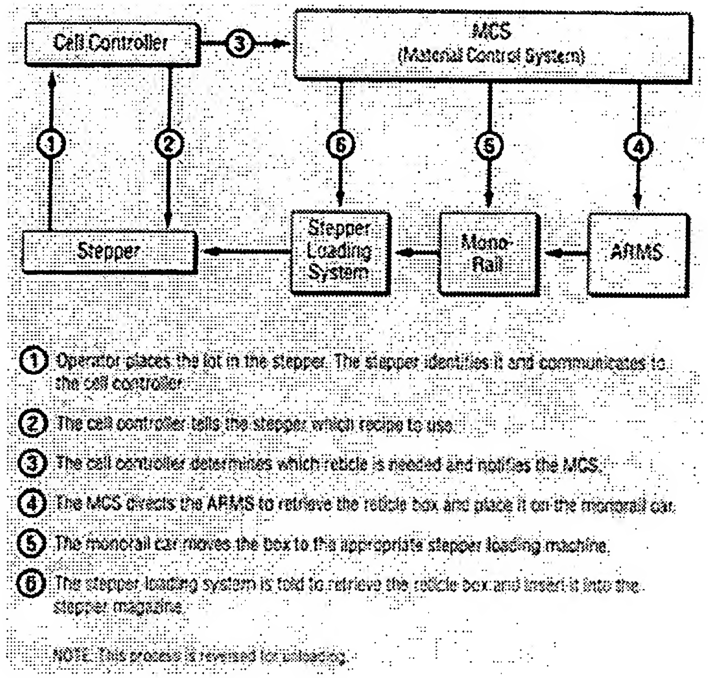

Figure 3.Automated reticle delivery.

Evaluating the Need for Automated Reticle Management

A customer's primary review of automated reticle management is the payback associated with reducing costs, increasing efficiency and throughput within the photolithography area. It is important to benchmark these critical success factors associated with the use of current methods prior to implementing automated methods.

Capital investment studies based on particulate contamination should consider specific production policies and practices. In addition to the benefits comparison of fully automated storage vs. manual methods, reticle cleaning procedures and inspection practices need to be measured.

When evaluating an automated reticle management system the following areas should be considered:

- Track reticle IDs and locations within the system.
- Meet or exceed cleanroom requirements.
- Monitor the number of uses per reticle in order to automate the cleaning intervals.
- Provide an expedient average reticle retrieval time.
- Scaleable storage capacity to meet current and future requirements.
- Minimal footprint with high density storage.
- Future Growth and Fab Planning

Leading semiconductor manufacturers are recognizing that material handling automation within the photolithography area is a critical step in closing the gap in factory automation. Their desires to prepare for the future through strategic facility planning, a need to effectively enhance the benefits of factory control systems, and concerns over clean room space costs are primary justifications behind investigation of automation within the lithography area. Automated reticle management systems and reticle transport and loading systems provide yet another building block in their move toward total fate automation.

Acknowledgments

The author would like to thank Tim McCabe and Bob Davis for their contributions to the technical product descriptions detailed in this paper. Also, Marlene Begay of Motorola for her participation in previous studies which provided some insight for this article.

About the Author

Denise Dillon Harris is a marketing project manager for PRI Automation. She graduated from Boston College with a BA in Business Administration. In her career, she has worked in several capacities in product and marketing management for over 10 years. Her work at PRI, spanning 6 years, has included new product design, functional system specifications and other product development projects. She has published several papers within the semiconductor industry.

If you have any enquiries regarding the content of this article, please contact:

PRI Automation Inc.
805 Middlesex Turnpike
Billerica
MA 01821
USA

Tel: (508) 663-8555
Fax: (508) 663-9755